

A CLARIFICATION OF THE STATUS OF *LIRIOMYZA TRIFOLII* (BURGESS) AND SOME RELATED SPECIES

(DIPTERA: AGROMYZIDAE)

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There has been much confusion regarding the true status of *Liriomyza trifolii* (Burgess), which was originally bred from leaf-mines on *Trifolium repens* L. in the District of Columbia. The name *trifolii* has recently been used by Griffiths, Hering, Nowakowski, and Spencer for the common European species mining Leguminosae in Europe, first described as *congesta* (Becker). Frick also identified as *trifolii* a species he bred from *Medicago*, *Trifolium*, and *Vicia* in Washington State. Hering (1957) described *L. pisivora*, bred from *Lathyrus* and *Pisum* in Germany, which cannot satisfactorily be distinguished on external characters from *congesta* (Becker). I have recently seen long series of a species bred from Leguminosae and six other families in Florida by C. Stegmaier which I considered to represent *L. archboldi* Frost; a further common species in Florida, occurring also on Leguminosae was identified as *L. guytona* Freeman (Spencer, 1963: 362).

I have now reviewed all my available material in this group, including specimens kindly lent by Prof. E. M. Hering, G. C. D. Griffiths, and G. Steyskal. I have been able to confirm the distinctness of *congesta* (Becker) and *pisivora* Hering. I have established that *trifolii* (Burgess) is distinct from these two European species and represents one of the two highly polyphagous species widespread in Florida. I have discovered that Frick's species from Washington is not *trifolii* (Burgess) but a new species described below as *fricki* sp. n. I have been able to clarify the position of *L. archboldi* Frost and *L. guytona* Freeman, which has now been found to be synonymous with *L. munda* Frick (Steyskal, 1964). I have also confirmed that *L. pictella* is definitely distinct from *L. munda*. These six species are discussed in more detail below.

I would like to thank George Steyskal, Insect Identification and Parasite Introduction Research Branch, U.S. Department of Agriculture, for a number of helpful comments on some of the problems dealt with in this paper and for assistance in final preparation of the manuscript.

Liriomyza archboldi Frost

Liriomyza archboldi Frost, 1962: 51-3. Holotype ♂ in coll. S. W. Frost.

Orbits entirely yellow, both vt on yellow ground, black of occiput reaching eye margin for short distance below outer vertical bristle; third antennal segment with conspicuously long pubescence; mesonotum brilliantly shining black, with large yellow patches in hind corners adjoining scutellum; mesopleura predominantly yellow, with black patch on lower margin and slightly extending up each side; anterior scutellar bristles arising from yellow ground; femora entirely yellow, tibiae

and tarsi darker, brown; wing length up to 1.75 mm, discal cell relatively large, last section of vein m4 slightly less than three times length of penultimate; male genitalia: aedeagus as in Fig. 1a, b; surstyli each with two strong teeth (Fig. 1c); spermal sac with blade conspicuously angular on outer corners (Fig. 1d).

The shining black mesonotum immediately distinguishes this species from *trifolii* (Burgess). In this character it resembles *munda* Frick but is distinguishable by the more pubescent third antennal segment, both vt and the anterior scutellars arising from yellow ground, and the distinctive genitalia.

The holotype and 20 paratypes were taken in a light trap in Florida. Specimens bred from *Pisum sativum* L. were included as paratypes but, following personal correspondence with Prof. Frost, it is now agreed that these represent *L. trifolii*. The host plant of *archboldi* thus remains to be clarified.

Material examined.

Florida: Highlands Co., Archbold Biological Station, 1 ♂ paratype, genitalia slide 780, taken at light, 9.xi.1959.

Liriomyza congesta (Becker)

Agromyza congesta Becker, 1903: 90. Three ♀ syntypes in Zoologisches Museum, Berlin.

Liriomyza congesta (Becker), Hendel, 1931–1936: 213.

Externally not distinguishable from *trifolii* (Burgess) apart from having acrostichals in two regular rows; male genitalia: aedeagus in side view as in Fig. 2a, mesophallus very small; distiphallus and mesophallus in ventral view as in Fig. 2b; spermal sac dark, blade large (Fig. 2c).

There has in the past been confusion over the status and possible synonymy of this species and *trifolii* (Burgess). Hendel (1931–1936: 214) thought the synonymy to be probable but not certain. Frick (1953) synonymized *congesta* with *trifolii* and was followed by Hering (1957), after seeing specimens of *fricki* sp. n. identified by Frick as *trifolii*. The name *trifolii* has subsequently been used by European workers in a number of minor papers. Sasakawa (1961) discusses *trifolii* in Japan but his genitalia drawings show that the species referred to is *pisivora* Hering.

Becker described this species from 1 ♂ and 3 ♀ caught in Egypt. I have seen the three female syntypes but the male appears to be lost. In its absence I do not propose to designate a lectotype. I have also seen males from Egypt recently caught on *Vicia faba* which clearly represent Becker's species. The genitalia of these and other specimens now show conclusively that *congesta* is entirely distinct from *trifolii*.

Hammad (1955) confirms this species on *Vicia faba* and *Pisum sativum* L. at Alexandria, Egypt.

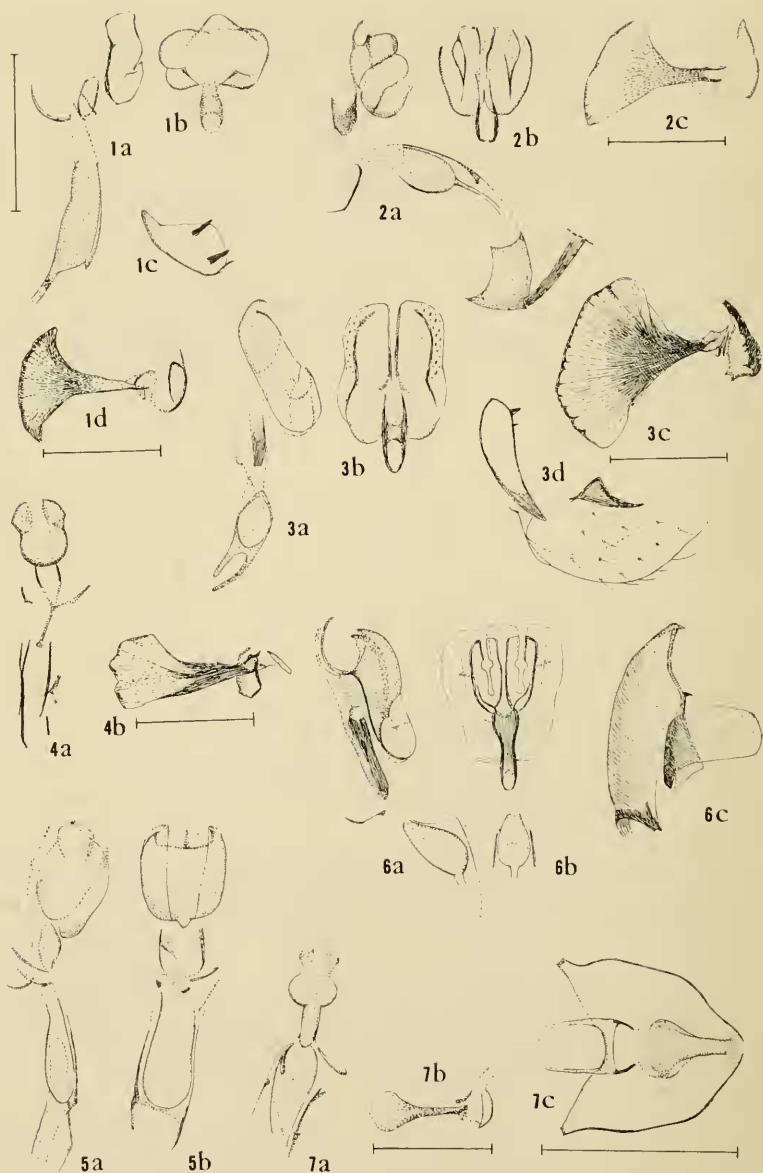


Fig. 1, *Liriomyza archboldi* Frost: a, aedeagus, side view; b, distiphallus, ventral view; c, surstylus; d, spermal sac. Fig. 2, *Liriomyza cougesta* (Becker): a, aedeagus, side view; b, distiphallus, ventral view; c, spermal sac. Fig. 3, *Liriomyza fricki* sp. n.: a, aedeagus, side view; b, distiphallus; c, spermal sac; d, surstylus. Fig. 4, *Liriomyza munda* Frick: a, aedeagus, ventral view; b, spermal sac. Fig. 5, *Liriomyza pictella* (Thompson): a, aedeagus, side view; b, same, ventral view. Fig. 6, *Liriomyza pisivora* Hering: a, aedeagus, side view; b, same, ventral view; c, sur-

The species is widespread in the Mediterranean area and throughout Western Europe.

Material examined.

- Egypt: Fayûm, 2 ♀ (syntypes), March 1899 (Becker, No. 44788); Cairo, 1 ♂, caught on *Vicia faba*, Jan. 1963.
Siala, 1 ♀ (syntype), March 1899 (Becker, No. 44878).
- England: Herts., Abbots Langley, 1 ♂, genitalia slide 606, ex *Vicia faba*, 3.ix.58 (K.A.S.).
Hunts., Woodwalton Fen, 1 ♂, caught 16.vii.60 (Griffiths).
Kent, Darenth, 1 ♂, ex *Vicia sepium* L., 13.v.1954 (Griffiths).
Middx, Finchley, 1 ♂, ex *Vicia cracca* L., 29.vii.53 (Griffiths).
- Persia: Gaht-i-Saar, 7,500 ft, 1 ♂, ex *Vicia persica* Boiss., 13.viii.61 (Griffiths).
- Spain: Algeciras, 1 ♂, genitalia slide 702, ex *Vicia faba*, 24.iv.55 (K.A.S.).
Canary Is., Palma, El Paso, 1 ♂, genitalia slide 763, ex *Vicia* sp., 12.iv.1926 (Hering).

***Liriomyza fricki* sp. n.**

Essentially as in *L. trifolii* (Burgess), with following points of difference:

Mesopleura almost entirely yellow, with at most a small, frequently indistinct, black bar below which does not extend along whole lower margin; femora entirely bright yellow, without any darker brown markings; acrostichals in two regular rows; male genitalia: aedeagus in side view as in Fig. 3a, distiphallus enlarged, elongated, mesophallus significantly shorter, darker, almost black; distiphallus and mesophallus in ventral view as in Fig. 3b; spermal sac with blade enormously enlarged (Fig. 3c), surstylus as in Fig. 3d.

Holotype ♂, genitalia slide 781, U.S.A., Washington State, Benton Co., Prosser, bred 3.vi.1953 ex leaf-mine on *Medicago sativa* L. (Lot No. 53.21), in U.S. National Museum. Paratypes 6 ♂, genitalia slide 640; 2, Prosser, ex *Vicia villosa* Roth., 18.vii.1950 (Lot No. 227-1), 4, Yakima Co., Buena, ex *Trifolium hybridum* L., 10.vi. and 19.vii.1950 (Lot No. 207-1), 4 in U.S. National Museum, 1 in Zoologisches Museum, Berlin, 1 in author's collection; entire series collected by K. E. Frick. There are 5 ♂ ♂ and 8 ♀ ♀ in the U.S. National Museum and in Frick's personal collection which I have not seen and which cannot be designated as paratypes.

This is the species used by Frick in preparing his key to North American *Liriomyza* species, where it is included as *trifolii* in Couplet

←

stylus. Fig. 7, *Liriomyza trifolii* (Burgess): a, aedeagus, ventral view; b, spermal sac; c, phallobase, epiphallus, and aedeagal hood.

Scale line = 0.1 mm, that in upper left-hand corner applying to all figures without accompanying line.

34 (Frick, 1959: 400 and 410). Apart from its more yellow coloration, *L. fricki* is immediately distinguishable from *trifolii* by the arrangement of the acrostichals in two regular rows.

***Liriomyza munda* Frick**

Liriomyza munda Frick, 1957: 60; 1959: 407. Steyskal, 1964: 388. Holotype ♂ in California Academy of Sciences.

Liriomyza guytona Freeman, 1958; Spencer, 1963: 362; Steyskal, 1964: 388. Holotype ♂ in U.S. National Museum.

Orbits yellow, both vertical bristles on dark ground, vti at margin of black and yellow; mesonotum brilliantly shining black; mesopleura largely yellow but variably black on lower half, either with separated black areas, as indicated by Frick for *munda* (1957: 67, Fig. E) or with entire lower half uniformly black. Male genitalia: aedeagus in ventral view as in Fig. 4a, distiphallus distinctly divided, pale, basiphallus with darker, asymmetrical sidearms; spermal sac dark (Fig. 4b).

Steyskal (1964) after comparing the holotypes of *guytona* Freeman and *munda* Frick synonymized *guytona* with *munda*. I have myself seen paratypes of *guytona* and *munda* and can confirm this synonymy. It has been further suggested by Steyskal (private communication) that *munda* may be synonymous with *propepusilla* Frost, 1954, but I prefer to leave the establishment of this possible synonymy to an American worker who is able to examine the holotype of *propepusilla*.

This is a highly polyphagous species. Frick (1957: 63) records tomato, potato, and *Datura meteloides* as hosts and also "frequenting tobacco." I have seen specimens, bred by C. Stegmaier in Florida, from *Bauhinia*, *Cajanus*, *Cassia*, *Cestrum*, *Cucumis*, *Cucurbita*, *Hydrocotyle*, *Passiflora*, *Phaseolus*, *Plantago*, *Ricinus*, and *Solanum*; I bred the species myself in Jamaica from *Moringa*.

***Liriomyza pictella* (Thomson)**

Agromyza pictella Thomson, 1868: 609. Holotype ♂ in Riksmuseum, Stockholm.

Liriomyza pictella (Thomson), Frick, 1957: 66; 1959: 408.

Orbits distinctly darkened to upper fronto-orbital; mesopleura predominantly black, only upper margin yellow. Male genitalia: aedeagus as in Figs. 5a, b; distiphallus shorter, broader than in *munda* and basiphallus paler, less chitinated.

I have examined the holotype from California. It is even darker than suggested by Frick and the mesopleura resemble the illustration given for *propepusilla* Frost (Frick, 1957: 67, Fig. A).

The differences in coloration and genitalia make this species immediately distinguishable from *munda* Frick.

Steyskal (private communication) has examined specimens identified by Frick as *pictella*, reared from a number of different plant families, and in all cases the species has proved to be *munda*. The name *pictella* must therefore, for the time being, be restricted to the holotype, the host plant of which is unknown.

Liriomyza pisivora Hering

Liriomyza pisivora Hering, 1957: 12. Holotype ♂ in Zoologisches Museum, Berlin.

Color exactly as in *congesta* (Becker) and *trifolii* (Burgess) except for the black bar on lower margin of mesopleura being possibly smaller, more as in *fricki*; acrostichals in two rows, slightly irregular. Male genitalia: aedeagus in side view as in Fig. 6a, mesophallus largely fused into greatly enlarged distiphallus (Fig. 6b); surstyli distinctive, appearing almost rectangular, with a blunt chitinized area on inner corner representing a rudimentary spine (spermal sac lost in only available specimen).

De Meijere (1925: 282) first established that a second species closely related to *congesta* (referred to as *leguminosarum* sp. n.) occurs on Leguminosae, and misidentified it as *pusio* Meigen. Hering (1957: 12) subsequently confirmed the distinctness of the two species on the basis of constant differences in larva and leaf-mine. In *pisivora* there are normally 4 or 5 and sometimes as many as 8 bulbs on each posterior spiracular process (3 only in *congesta*); the leaf-mine normally begins on and is frequently largely confined to the lower surface (largely upper surface in *congesta*). Hering has noted the mine in Germany on *Lathyrus* spp. and *Pisum* spp.

It is not possible satisfactorily to distinguish *pisivora* from *congesta* on external characters.

Material examined.

Germany: Berlin Botanical Gardens, 1 ♂ paratype, genitalia slide 754, ex *Lathyrus silvestris* L., 8.vii.1951 (E. M. Hering).

Liriomyza trifolii (Burgess)

Oscinis trifolii Burgess, 1879: 201. There are no types in the U.S. National Museum and they must be presumed lost.

Agromyza trifolii (Burgess): Coquillett, 1898, Bull. Dept. Agric. Ent. 10: 78; Malloch, 1913, Ann. Ent. Soc. Amer. 6: 278.

Liriomyza trifolii (Burgess): de Meijere, 1925: 282; Hendel, 1931-1936: 213; Frick, 1952: 405; 1959: 410; Spencer, 1963: 354 (as *archholdii* Frost).

Burgess described this species from material bred from leaf-mines on *Trifolium repens* L. in the District of Columbia. In the absence of any type specimens and in view of the past confusion over the status of this species, it is considered desirable to establish a neotype. The specimen selected, a male bred from "alfalfa" (*Medicago sativa* L.) at Lafayette, Ind., 3.xi.1913 (J. M. Aldrich), is in the U.S. National Museum.

The essential characters of the species are as follows:

Orbits entirely yellow, both vertical bristles on yellow ground; black of occiput reaching eye margin beyond outer vertical bristle; all antennal segments bright yellow, third only finely pubescent; mesonotum blackish grey, distinctly pollinose; acrostichals irregularly in 3 or 4 rows in front, reduced to two rows behind, yellow

patch at each corner adjoining scutellum; mesopleura with black patch normally extending along lower margin, sternopleura largely black, upper margin yellow; abdomen with tergites variably yellow laterally and on hind margins; legs: coxae yellow, femora largely so but with slight, variable brownish striation; tibiae and tarsi darker, brown. Male genitalia: illustrated by Spencer (1963: Fig. 73a, b, c, as *archboldi* Frost); distiphallus pale, distinctly divided into two symmetrical halves, slightly variable in form and length (Fig. 7a), mesophallus always narrow, obviously elongate; basiphallus entirely pale distally, more distinctly formed behind on one side only; surstyli ending in one well-developed spine with two slight hairs; spermal sac (Fig. 7b) pale, narrow, relatively small; phallopore, epiphallus, and aedeagal hood as in Fig. 7c.

The differences in the aedeagus between *trifolii* and *munda* are surprisingly small. In *trifolii* the mesophallus is distinctly narrower, more elongate, and the basiphallus is less strongly chitinized, appearing quite black in *munda*. These two species can be more reliably separated on external characters as follows:

Mesonotum brilliantly shining black; both vertical bristles arising from dark color *munda* Frick

Mesonotum blackish-grey, distinctly pollinose; both vertical bristles arising from yellow *trifolii* (Burgess)

There appears to be a distinct variation in the distiphallus of *trifolii*. It is virtually identical in the neotype and in a specimen ex *Tridax procumbens* (genitalia slide 528) but more elongate and less indented in a specimen ex *Pisum* (genitalia slide 610, previously illustrated, 1963: Fig. 73b); there are minor variants between these two extremes in the seven other specimens I have examined. The genitalia are identical in other respects, as are the adults on external characters. A comparable variation has been noted in another highly polyphagous species, *Phytomyza atricornis* Mg. More detailed study will be required to decide whether this variation represents incipient speciation or whether it can in some way be explained as an associated characteristic of the polyphagy of the species concerned.

Frick (1959: 400) keys out this species as having two rows of acrostichals. This is not correct. Frick was misled on this point by considering as *trifolii* specimens he collected in Washington in which the acrostichals are in two rows but which represent the new species *fricki* described earlier in this paper.

L. trifolii occurs commonly in Florida on *Phaseolus*, *Pisum*, and *Vigna* but it also occurs there on *Allium*; *Capsicum* and *Solanum*; *Hibiscus*; *Cucumis* and *Cucurbita*; *Tribulus*; and very frequently on *Compositae*. It is a dominant, polyphagous species and not limited to Leguminosae, as has been the concept hitherto.

Frick (1953: 72) accepts *Oscinis trifolii* Burgess as a homonym and

synonym of *Agromyza trifolii* Kaltenbach, 1874; he then places *Liriomyza trifolii* (Burgess) as a synonym of *L. congesta* (Becker). These two proposals are inaccurate both nomenclatorially and taxonomically; de Meijere (1925: 282) first suggested the homonymy of *Oscinis trifolii* Burgess and *Agromyza trifolii* Kaltenbach but Hendel (1931-1936: 213) rightly pointed out that this was not so. *Agromyza trifolii* Kaltenbach is itself a synonym of *A. nana* Meigen.

In Frick's (1959: 400) key to North American *Liriomyza* species *L. trifolii* runs to *alliovora* in couplet 32, not to couplet 34 as shown (Frick's *trifolii* represents *fricki* n. sp.)

Material examined.

Medicago sativa L.: Indiana, Lafayette, 1 ♂, 3.xi.1913 (neotype).

Trifolium repens L.: Florida, Hialeah, leaf-mines only, 16.vi.1963 (C. Stegmaier).

Phaseolus sp.: Florida, Hialeah, ♂ ♂ and ♀ ♀, 3.iv.1963 (C. Stegmaier).

Pisum sp.: Florida, Hialeah, ♂ ♂ and ♀ ♀, genitalia slide 610, Feb. 1963 (C. Stegmaier).

Cucumis sp.: Florida, Immokake, 2 ♂, 2 ♀, genitalia slide 382, 3.ix.1961 (W. C. Allertz); Hialeah, ♂ ♂ and ♀ ♀, genitalia slide 605, Feb. 1963 (C. Stegmaier).

Cucurbita sp.: Florida, Hialeah, ♂ ♂ and ♀ ♀, Feb. 1963 (C. Stegmaier).

Capsicum sp. (green pepper). Florida, Hialeah, ♂ ♂ and ♀ ♀, Apr. 1963 (C. Stegmaier).

Solanum nigrum L.: Florida, Hialeah, ♂ ♂ and ♀ ♀, genitalia slide 605, Feb. 1963 (C. Stegmaier).

Kallstroemia maxima (L.) T. & G.: Florida, Miami Beach, ♂ ♂ and ♀ ♀, May 1963 (C. Stegmaier).

Tribulus terrestris L. (Zygophyllaceae): Florida, Hialeah, ♂ ♂ and ♀ ♀, genitalia slide 740, May 1963 (C. Stegmaier).

Baccharis halimifolia L.: Florida, Hialeah, ♂ ♂ and ♀ ♀, Feb. 1963 (C. Stegmaier).

Bidens pilosa L.: Florida, Miami, ♂ ♂ and ♀ ♀, genitalia slide 531, Aug. 1962 (C. Stegmaier).

Dahlia sp. (cult.): Florida, Hialeah, ♂ ♂ and ♀ ♀, 30.viii.1962 (C. Stegmaier).

Erechtites hieracifolia (L.) Rafin.: Florida, Hialeah, ♂ ♂ and ♀ ♀, Feb. 1963 (C. Stegmaier).

Eupatorium coelestinum (L.): Florida, Hialeah, ♂ ♂ and ♀ ♀, 18.ix.1963 (C. Stegmaier).

Flaveria trinervia Mohr: Florida, Miami, ♂ ♂ and ♀ ♀, 15.viii.1962 (C. Stegmaier).

- Gaillardia aristata* Pursh.: Florida, Key Bahia Honda, ♂ ♂ and ♀ ♀, Aug. 1963 (C. Stegmaier).
- Gerbera jamesoni* Bolus: Florida, Coral Gables, ♂ ♂ and ♀ ♀, May 1913 (C. Stegmaier).
- Lactuca* sp.: Florida, Hialeah, ♂ ♂ and ♀ ♀, Feb. 1963 (C. Stegmaier).
- Tagetes* sp.: Florida, Hialeah, ♂ ♂ and ♀ ♀, Feb. 1963 (C. Stegmaier).
- Tridax procumbens* L.: Florida, Miami, ♂ ♂ and ♀ ♀, genitalia slide 528, Aug. 1962 (C. Stegmaier).
- Zinnia* sp. Florida, Hialeah, 1 ♂, 1 ♀, 2.vii.1963 (C. Stegmaier).

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